

Remarks

Claims 1-30 are pending. In the Final Office Action mailed 11 September 2007, the Examiner has finally rejected claims 1, 5-11, 13, 17, 20-25, 27, 29, and 30 under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent 5,777,644 (Yamaguchi) in view of U.S. Patent 6,312,110 (Darty), claims 3-4, and 16 as being unpatentable over Yamaguchi and Darty in further view of U.S. Patent 6,695,439 (Takahashi), and claims 12 and 26 as being unpatentable over Yamaguchi and Darty in view of U.S. Patent 5,801,730 (Shima). The Examiner also finally rejected claims 14 and 28 as being unpatentable over Yamaguchi and Darty in further view of U.S. Patent 5,227,814 (Mutou), and claims 18-19 as being unpatentable over Yamaguchi and Darty in further view of U.S. Patent 6,224,193 (Minemoto).

Applicant has amended independent claims 1, 15, 16, 17, 29, and 30 to incorporate features recited in various dependent claims regarding the configuration to stop the discharge of ink through the nozzle. Support for the claim amendments may be found in paragraph 50 of the specification as filed. Applicant has canceled claims 6, 7, 21, and 22 with their limitation merged into corresponding base claims.

35 U.S.C. §103(a) Rejections

The Examiner rejected all claims over Yamaguchi in combination with Darty, or Yamaguchi and Darty in various combinations with other prior art of record. Applicant respectfully traverses the rejections, and requests reconsideration and withdrawal thereof. The rejections will be discussed in regard to amended independent claim 1.

Amended independent claim 1 recites an apparatus for electrorheological printing. The apparatus comprises a pressurized ink chamber configured to contain an electrorheological ink. The pressurized ink chamber is in fluid communication with a nozzle. The apparatus further comprises a stimulator configured to generate a synchronization signal to increase the pressure in the pressurized ink chamber, where the pressure within the pressurized ink chamber causes the electrorheological ink to discharge through the nozzle. The apparatus further comprises an electrode arrangement configured to create an electric field to control a rate of discharge of the electrorheological ink through the nozzle. The electrode arrangement is further

configured to create an electric field with a magnitude sufficient to stop the discharge of the electrorheological ink through the nozzle and to create an electric field having a lesser magnitude to permit ink to discharge through the nozzle. Applicant submits that neither Yamaguchi nor Darty (individually or in combination) teaches or reasonably suggests an electrode arrangement configured to create an electric field sufficient to stop the discharge of pressurized electrorheological ink through a nozzle and to create a lesser electric field to permit discharge through the nozzle.

Yamaguchi teaches in FIG. 1 a fluid chamber 5 containing ink. The fluid chamber is connected to a discharge port 2 at one end that never leaks ink because the surface tension of the ink is balanced with atmospheric pressure (Column 3, lines 30-32). In other words, the ink fluid chamber is not nominally pressurized but rather is at equilibrium with atmospheric pressure to avoid constant discharge of ink through his nozzle structure 3. Because ink chamber 5 is unpressurized (i.e. at atmospheric pressure), a piezoelectric element 7 is required in each channel to apply discharge pressure to the ink (Column 3, lines 27-33). Yamaguchi further teaches forming multiple flow channels in an ink chamber containing electrodes (Column 1 line 64, to Column 2, line 7). These electrodes are arranged perpendicular to the ink discharge direction to form ink channels or walls (Column 3, lines 59-64). Because the electrodes are arranged with gaps to form channels, the electrodes can not stop the flow of ink through the nozzle. In other words, Yamaguchi cannot configure his electrodes to stop all flow of his ink – he can only selectively control the array of electrodes to redirect the flow toward particular channels. To completely stop any flow, Yamaguchi simply does not actuate any of the piezoelectric elements 7 (stimulators) to apply pressure to the ink. Thus the ink remains un-pressurized and does not flow through his nozzle. If no electrode pairs (6a and 6b) are energized to form fields, no walls are formed and ink flows freely throughout the nozzle 2 of Yamaguchi if the piezoelectric elements are actuated. There is no configuration possible of Yamaguchi's electrode pairs that can stop all flow of ink through the nozzle port 2.

Even a configuration of all electrodes as shown in his figure 17c where all electrodes are energized to form walls, the cross-talk between adjacent electrode fields forms an insufficient field to completely "plug the hole" and thus some ink will flow through some part of the nozzle port 2 (probably through all parts thereof but at a slower

rate). In Yamaguchi's discussion of the problems of cross-talk in a perpendicular-to-ink electrode arrangements as shown in FIG. 17C, the increase in ink viscosity is not sufficient to prevent the ink from being discharged because of the electrode gap width at the nozzle. (Column 9, lines 37-49). Thus, Applicant submits that Yamaguchi does not teach an electrode arrangement configured to create an electric field sufficient to stop the discharge of pressurized electrorheological ink through a nozzle.

Darty teaches electrohydrodynamic (EHD) ejection of ink from a print head (Abstract). Darty further teaches in FIG. 1 and FIG. 6 that electrodes are configured as rings on opposite ends of the print head (nozzle). In operation, the ink is charged and reacts with an electrostatic field formed by the electrodes to move the ink through the print head (Column 3, lines 14-18). Because Darty utilizes EHD ejection of charged ink from the print head, pressurized ink is neither taught nor required for print head operation. There is no pressurized ink in Darty. The only forces applied to discharge ink through the nozzle is from the electrostatic field generated in his nozzle electrode configuration. Thus the electrodes of Darty cause the flow or discharge of ink. No electric field of Darty can be created to stop the flow of ink. Rather, in Darty, the absence of an electric field is how the flow of ink is stopped (i.e., the "pump" action of the electric field is terminated). Although Darty discloses in FIG. 3 a means for applying an oppositely charged voltage to the electrodes to control and limit the amount of ink ejected from the print head, Darty does not teach or reasonably suggest that this configuration is operable to stop the flow of ink through the print head (Column 4, lines 16-22).

Applicant therefore maintain that for at least the reasons provided above, neither Yamaguchi nor Darty individually teaches or reasonably suggests creation of an electric field capable of stopping the flow of pressurized electrorheological ink through a nozzle. Since neither reference teaches such a structure, neither do the references as combined teach such a structure. Applicant therefore maintains that independent claim 1 is allowable over all art of record, considered individually or in any combination. Applicant further maintains that dependent claims 2-5, and 8-14 are allowable for at least the reasons provided above and for depending on allowable base claim 1.

Independent claims 15, 16, 17, 29, and 30 recite similar limitations to claim 1 and are therefore maintained to be allowable for at least the reasons provided for claim 1.

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Dependent claims 18-20 and 23-28 are also maintained to be allowable for at least the same reasons and as dependent from allowable base claims.

Conclusion

Applicant has amended independent claims 1, 15, 16, 17, 29, and 30 for editorial clarity and to better protect the invention. Applicant has canceled claims 6, 7, 21, and 22.

Applicant has traversed and thoroughly discussed the Examiners rejection of the pending claims and maintains that the claims are novel and non-obvious over all art of record, considered individually or in any combination. Applicant therefore respectfully requests reconsideration and withdrawal of the rejections.

Applicant believes that no fees are due in this matter. Should any issues remain, the Examiner is encouraged to telephone the undersigned attorney.

Respectfully submitted,

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